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Assessing Impacts of Water Management on Reservoir Fish Reproductive Success in the Alabama-Coosa-Tallapoosa/ Apalachicola-Chattahoochee-Flint River Basins

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Prepared for U.S. Army Engineer District, Mobile

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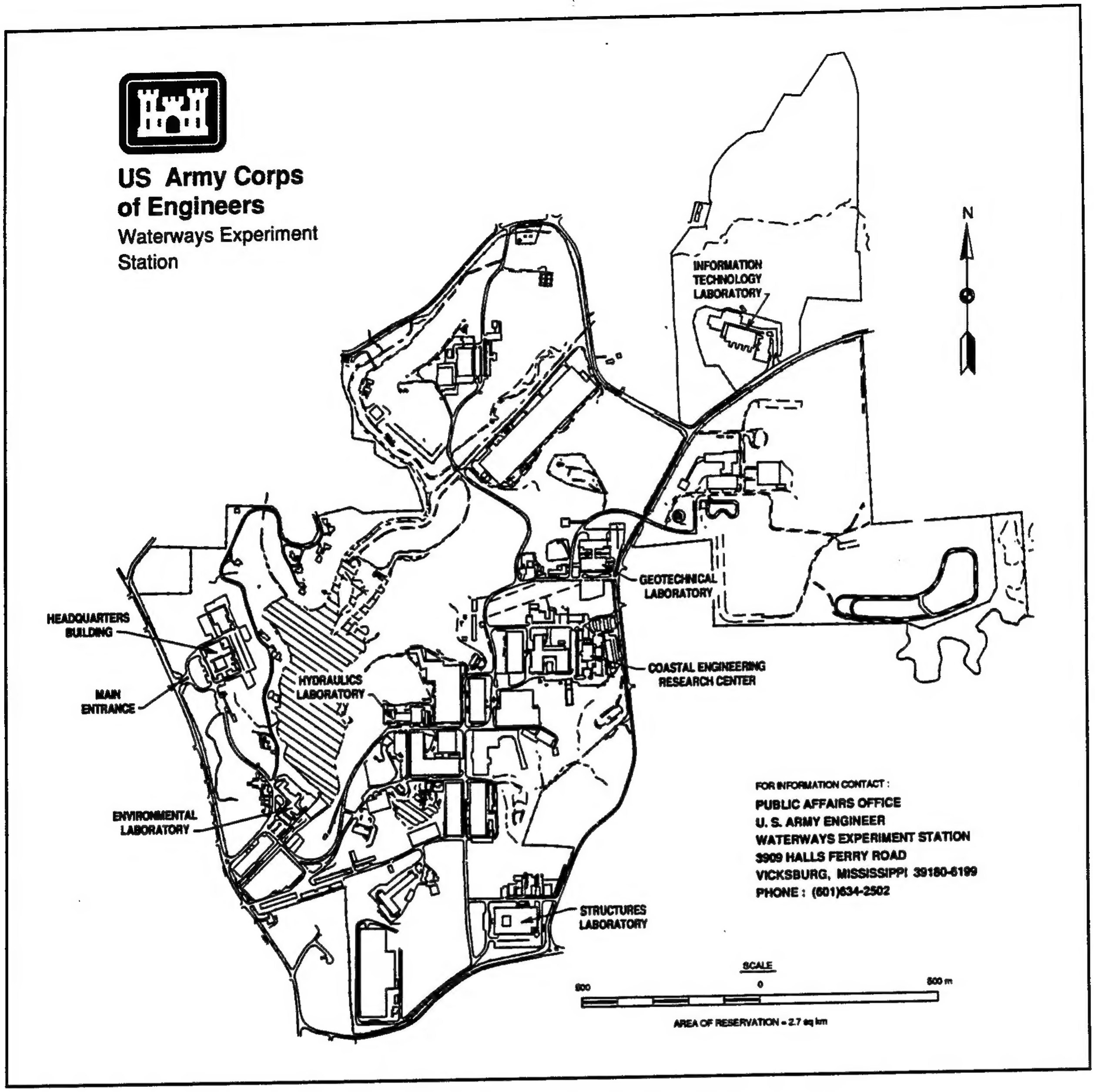

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Contents

Preface

The report herein was prepared by the Water Quality and Contaminant Modeling Branch (WQCMB), Environmental Processes and Effects Division (EPED), Environmental Laboratory (EL), U.S. Army Engineer Waterways Experiment Station (WES) and the National Biological Survey (NBS), Georgia Cooperative Fish and Wildlife Research Unit, University of Georgia, Athens, GA, for the U.S. Army Engineer District, Mobile, AL, the Alabama Department of Economic and Community Affairs, the Georgia Department of Natural Resources, and the Northwest Florida Management District.

The report was prepared by Messrs. Gene R. Ploskey, WQCMB, and Thomas R. Reinert, NBS, and was conducted under the general supervision of Dr. Mark S. Dortch, Chief, WQCMB; Mr. Donald L. Robey, Chief, EPED; Dr. John W. Keeley, Director, EL; and Dr. Michael J. Van Den Avyle, NBS.

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Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
acre-feet	1233.489	cubic meters
acres	0.40470	hectares
cubic feet/sec	0.02832	cubic meters/sec

1 Introduction

Study Design

The Tri-State Comprehensive Water Management Study is a joint effort by Alabama, Florida, Georgia, and the U.S. Army Engineer District, Mobile. The objective is to assess effects of current and proposed water-management strategies on various uses of the Alabama-Coosa-Tallapoosa (ACT) and Apalachicola-Chattahoochee-Flint (ACF) river basins.

Our part of the study was to derive regression models for evaluating effects of water-resource alternatives on fish reproductive success, as indexed by catches of young fish in a variety of gears, in ACT/ACF impoundments. Our approach was similar to an analysis of fish-population responses in Missouri River reservoirs (Ploskey et al. 1993). It involves using correlation and multiple-regression techniques and requires adequate historical hydrologic and fishery data.

Scientific Basis

Fishery biologists often associate strong year classes of many warm-water fishes with years of above-average inflow and water levels in reservoirs. Hydrologic patterns increasing year-class strength usually involve substantial increases in inundated area, occur over several seasons or years, and may be accentuated by topography, soil conditions, and vegetation (Wood and Pfitzer 1960; Ploskey 1986). In contrast, daily or weekly fluctuations may have negative effects on spawning and hatching (Shields 1957; Bennett 1975; Heisey et al. 1980; Bennett et al. 1985; Kohler et al. 1993), although not necessarily year-class strength (Gasaway 1970; Estes 1971; Kohler et al. 1993). Responses of many species are positive and more pronounced in hydropower storage reservoirs—storage ratio (mean volume / annual discharge) > 0.165 years—than they are in hydropower mainstream impoundments—storage ratio < 0.165 years (Aggus and Lewis 1977). Negative correlations of catches of age-0 fishes with flushing rate variables are sometimes observed for mainstream reservoirs (Ploskey et al. 1984, 1993) and may result from high rates of water exchange that limit time available for nutrient processing or

flush many age-0 fish from the reservoir. Standing crops of fish in storage reservoirs increase in response to increased rates of water exchange and area. In wet years, flushing rate and standing crop approach values more typically observed in productive mainstream impoundments (Aggus and Lewis 1977).

The literature is replete with associations of successful reproduction and development of strong year classes of fish with years of high water inundating terrestrial vegetation in reservoirs (see Benson 1968; Beckman and Elrod 1971; Nelson and Walburg 1977; Nelson 1978; Ploskey 1986; Kohler et al. 1993). Catches of many young fishes are highest in high-water years, in spite of substantial dilution by increased water volume. High inflow in storage reservoirs increases surface area to absorb solar insolation, inundates terrestrial areas, increases nutrient loadings (Westerdahl et al. 1981; Johnson and Ford 1987), and stimulates primary and secondary production (Benson and Cowell 1967; Mitchell 1975; Vollenweider 1975; Ostrofsky and Duthie 1978; McCammon and von Geldern 1979; Grimard and Jones 1982). Flooded vegetation affords fishes optimum spawning and nursery habitat, e.g., yellow perch (Beckman and Elrod 1971), northern pike (Benson 1968; Hassler 1970), buffaloes (Moen 1974), and common carp (Gabel 1974), that enhance their survival (Martin et al. 1981).

Responses of largemouth bass (*Micropterus salmoides*) and to a lesser extent spotted bass (*M. punctulatus*) have been studied often because of black bass prominence in warm-water fisheries and their sensitivity to water-level changes (Jenkins 1970). Smallmouth bass (*M. dolomieui*) responses are different from those of largemouth and spotted bass (Aggus and Elliott 1975), underscoring the need for care in assigning a species to a reproductive guild (Austin et al. 1994). Increased reproductive success of largemouth bass in wet years has been related to many factors, including increased nutrient loading (Wright 1950; Wood 1951; Shirley and Andrews 1977; Aggus 1979), primary production (Benson 1968), and inundation of vegetated terrestrial vegetation (Bryant and Houser 1971; von Geldern 1971; Keith 1975; Aggus and Elliott 1975; Rainwater and Houser 1975; Houser and Rainwater 1975; Shirley and Andrews 1977; Strange et al. 1982; Miranda et al. 1984). Inundation of terrestrial vegetation usually increases food availability, condition factors, or growth (Moffet 1943; Stroud 1948; Jackson 1958; Applegate et al. 1967; Mullan and Applegate 1968; Allan and Romero 1975; Aggus and Elliott 1975; Houser and Rainwater 1975; Rainwater and Houser 1975; Vogele and Rainwater 1975; Summerfelt and Shirley 1978; Shelton et al. 1979; Timmons et al. 1980).

River Basin Descriptions

Apalachicola-Chattahoochee-Flint

The ACF river basin is located primarily in the state of Georgia. It drains about 19,560 square miles, including a portion of eastern Alabama and western Georgia and flows through the Florida panhandle to the Gulf of Mexico. Its

three major rivers drain mountain, piedmont, and coastal-plain regions . The Chattahoochee River is 430 miles long and drains 8,700 square miles. The average discharge is 11,500 ft^3/sec. It begins in the mountain foothills of northeast Georgia and flows southwest, through Atlanta, to form the Alabama-Georgia border from West Point south until its confluence with the Flint River in Lake Seminole (Couch, 1993). The Flint River is 340 miles long and drains 8,460 square miles. Its headwaters are just south of Atlanta in the piedmont region of the state. The river flows south into Lake Seminole. Typical discharge is 9,800 ft^3/sec (Couch, 1993). The Apalachicola River forms from the confluence of the Chattahoochee and Flint rivers in Lake Seminole. It flows south 106 miles to the Gulf of Mexico and drains 2,400 square miles (Couch, 1993).

Alabama-Coosa-Tallapoosa

The ACT river basin begins in Georgia and drains a portion of Tennessee and northwest Georgia. The 22,800-square-mile drainage area includes much of central Alabama and eventually drains into Mobile Bay, Gulf of Mexico. It drains mountain, piedmont, and coastal-plain regions (Jack G. Ward, Mobile District Army Corps of Engineers, pers. comm.). The Coosa River is formed by the confluence of the Etowah and Oostanaula rivers near Rome, GA. It flows southwest for approximately 110 mi before turning south for 176 mi until it reaches the Tallapoosa River near Wetumpka, AL. It drains an area of 6,290 square miles, of which 750 are in Georgia (J.G. Ward, pers. comm.). The Tallapoosa River has its headwaters in northwest Georgia approximately 40 mi west of Atlanta. It flows in a southerly direction for 195 miles before turning west for 40 miles until it reaches the Coosa River at Wetumpka, AL. It drains an area of 4,660 square miles, of which 720 are in Georgia (J.G. Ward, pers. comm.). The Alabama River is formed by the confluence of the Coosa and Tallapoosa rivers near Wetumpka, AL. It flows for approximately 310 miles in a southwesterly direction to its outlet in Mobile Bay, Gulf of Mexico. It drains an area of 7,870 square miles. (J.G. Ward, pers. comm.).

2 Methods

Fishery Data

Fisheries data from all major ACT/ACF reservoirs were inventoried to identify impoundments with sufficient data for regression modeling of effects of hydrology on fish reproductive success. District offices of the Alabama Department of Conservation and Natural Resources and the Georgia Department of Natural Resources were contacted to determine the availability of data, as were individuals with Auburn University, Alabama Power Company, and U.S. Army Engineer District, Mobile. The project was presented as, "A feasibility analysis for relating fish reproductive success to operational characteristics of reservoirs in the ACT/ACF system." We asked contacts to identify years of samples by method, season, spatial extent, format, and availability (for use in this study). Data formats included field sheets, summary reports, and computer files. Publications also were requested.

Our index to reproductive success of largemouth bass and spotted bass was computed as $\log_{10}(\text{catch} + 1)$ for age-0 or age-1 fishes by sampling method. Catch was expressed as kg/ha for cove-rotenone samples and number/hour for electrofishing. Age was estimated from plots of successive years of length-frequency data.

Hydrologic Data

Reservoir hydrologic data were requested from the U.S. Army Engineer District, Mobile, and two private power companies for reservoirs that appeared to have sufficient fishery data for modeling. Data consisted of elevation-area-volume tables and daily inflows, releases, and water surface elevations. We derived independent variables as surface area or volume rather than elevation so that dimensions were consistent with those for nutrient loading, reservoir productivity, and fish standing crop. Volume and area were calculated from elevation using quadratic equations fit to empirical data (Table 1).

Table 1
Coefficients of Quadratic Regression Equations for Predicting Volume or Area from Elevations

Lake	A0	A1	A2	V0	V1	V2
Allatoona	813649.0515	-2189.4795	1.4706	32939648.0737	-87845.8283	58.4414
Carters	32319.4881	-77.1314	0.0466	6052432.2346	-13712.1627	7.8533
West Point	2521443.8631	-8665.5898	7.4576	79042154.3498	-272415.7872	234.4966
Walter F. George	172476.2849	-2791.2742	11.1765	4701867.0821	-73919.8891	285.4073

Equations have the form: acres = A0 + A1×ELEV + A2×ELEV^2 and acre-ft = V0 + V1×ELEV + V2×ELEV^2, where A0, A1, A2, V0, V1, and V2 are tabled coefficients and ELEV = elevation, mean sea level.
Acres and acre-ft were converted to hectares and $m^3 \times 10^6$, respectively before hydrologic variables were derived.

All equations had coefficients of determination (r^2) > 0.99, P < 0.0001, and N > 40. We redefined the annual hydrograph as running from September through August of the next year so that the last month coincided with annual cove-rotenone sampling of fish. We derived variables based upon flow, volume, area, or select ratios thereof from time segments potentially affecting fish reproductive success (Table 2). Many hydrologic variables were intercorrelated, but our concern during the variable-creation phase was completeness rather than independence suitable for multiple regression analysis.

Data Analyses

We limited analyses to effects of hydrology on black basses in four reservoirs because funding was eliminated after the Technical Coordination Group, Tri-state Comprehensive Study, reviewed the initial data inventory. Largemouth bass occurred in all four study reservoirs, and it dominated black-bass species composition in West Point and Walter F. George (ACF basin). Carters and Allatoona reservoirs (ACT Basin) had larger populations of spotted bass than largemouth bass. Largemouth and spotted bass were selected because they were the primary focus of most fisheries sampling and are known to be responsive to hydrologic variation (Miranda et al 1984; Ploskey 1986; Willis 1986). We generated correlations matrices and single-variable regression models relating the standing crop (for Allatoona, West Point, and Walter F. George reservoirs) and electrofishing catch (for all four reservoirs) of age-0 and age-1 largemouth or spotted bass to reservoir hydrology.

Table 2
Abbreviations and Definitions of Temporal Hydrologic Variables

Variable	Definition
CASUSP	Change in area, summer-spring = mean of hectares on 31 Mar, 30 Apr, and 31 May minus mean on 30 Jun, 31 Jul, and 31 Aug of year - 1 divided by mean on 30 Jun, 31 Jul, and 31 Aug of year - 1
CASUSP2	Change in area, summer-spring = mean of hectares on 30 Apr, 31 May, and 30 Jun minus mean on 30 Jun, 31 Jul, and 31 Aug of year - 2 divided by mean on 30 Jun, 31 Jul, and 31 Aug of year - 2
CASUSU	Change in area, summer-summer = mean of hectares on 30 Jun, 31 Jul, and 31 Aug minus mean for the same dates in year - 1 divided by mean on the same dates of year - 1
CASUSU2	Change in area, summer-summer = mean of hectares on 30 Jun, 31 Jul, and 31 Aug minus the mean for the same dates in year - 2 divided by mean on the same dates of year - 2
XVOL1_8	Mean volume = mean of $\log_{10}$(end-of-month $m^3 \times 10^6$), Jan-Aug
SINF1_8	Mean inflow = $\text{Log}_{10}(m^3 \times 10^6)$, Jan-Aug
SREL1_8	Mean release = $\text{LOG}_{10}(m^3 \times 10^6)$, Jan-Aug
FR1_8	Flushing rate = sum of release volume / mean volume, Jan-Aug
RIR1_8	Ratio of inflow to release = inflow / release, Jan-Aug
XVOL9_11	Mean volume = mean of $\log_{10}(m^3 \times 10^6)$ on 30 Sep, 31 Oct, and 30 Nov of the previous year
SINF9_11	Sum of inflow = $\log_{10}$(sum of $m^3 \times 10^6$), Sep-Nov (previous year)
SREL9_11	Sum of release = $\log_{10}$(sum of $m^3 \times 10^6$), Sep-Nov (previous year)
FR9_11	Flushing rate = sum of release / mean volume, Sep-Nov (previous year)
RIR9_11	Ratio of inflow to release = inflow / release, Sep-Nov (previous year)
XA9_11	Mean area = mean of $\log_{10}$(hectares) on 30 Sep, 31 Oct, and 30 Nov (previous year)
PA9_11	Perimeter area = mean of $\log_{10}$(hectares over depths ≤6 m) on 30 Sep, 31 Oct, and 30 Nov (previous year)
CA9_11	Change in area = (30-Nov area – 30-Sep area) / 30-Nov area (previous year)
XVOL3_5	Mean volume = mean of $\log_{10}(m^3 \times 10^6)$ on 31 Mar, 30 Apr, and 31 May
SINF3_5	Sum of inflow = $\log_{10}$(sum of $m^3 \times 10^6$), Mar-May
SREL3_5	Sum of release = Log_{10}(sum of $m^3 \times 10^6$), Mar-May
FR3_5	Flushing rate = sum of release / mean volume, Mar-May
RIR3_5	Ratio of inflow to release = inflow / release, Mar-May
XA3_5	Mean area = mean of $\log_{10}$(hectares) on 31 Mar, 30 Apr, and 31 May
PA3_5	Perimeter area = mean of $\log_{10}$(hectares over depths ≤6 m) on 31 Mar, 30 Apr, and 31 May
CA3_5	Change in area = (31-Mar area – 31-May area) / 30-Mar area
XVOL6_8	Mean volume = mean of $\log_{10}(m^3 \times 10^6)$ on 30 Jun, 31 Jul, and 31 Aug
SINF6_8	Sum of inflow = $\log_{10}$(sum of $m^3 \times 10^6$), Jun-Aug
SREL6_8	Sum of release = Log_{10}(sum of $m^3 \times 10^6$), Jun-Aug
FR6_8	Flushing rate = sum of release / mean volume, Jun-Aug
RIR6_8	Ratio of inflow to release = inflow / release, Jun-Aug
XA6_8	Mean area = mean of $\log_{10}$(hectares) on 30 Jun, 31 Jul, and 31 Aug
PA6_8	Perimeter area = mean of $\log_{10}$(hectares over depths ≤6 m) on 30 Jun, 31 Jul, and 31 Aug
CA6_8	Change in area = (30-Jun area – 31-Aug area) / 30-Jun

3 Results

The state of Georgia initiated a standardized sampling program in 1981 that included seining, gillnetting, and electrofishing. Cove-rotenone sampling was to be conducted as conditions warranted. The objective was to monitor the principal game and forage fish species in Georgia reservoirs over 200 ha. Seine sampling was listed as the primary method for assessing young-of-year growth and abundance (GA-DNR 1981). The state of Alabama instituted the Alabama Reservoir Management Program in 1986. Its objective was to collect "baseline information on the major sport fish species of the State's reservoirs...to follow trends in fish growth, recruitment, and mortality and identify any fishery problems" (McHugh et al. 1991).

After examining all available data (Table 3), we found two reservoirs from the ACF (West Point and Walter F. George) and two from the ACT (Carters and Allatoona) that had sufficient data for further study. Sufficient fishery data also were available for Blackshear and Bartlett's Ferry, but hydrologic data were not furnished by private power companies.

Most available fisheries data for the ACF system came from district offices of the Georgia Department of Natural Resources (Table 4). Although outlined in 1981, standardized sampling procedures did not begin in all reservoirs at this time. Sampling began in West Point around 1982, but most other major reservoirs were not consistently sampled until 1985 or later. The original sampling protocol included seining (to determine abundance of young-of-year fishes), electrofishing (to determine relative abundance, age, growth and relative condition of principal centrarchid species), and gill netting (to determine relative abundance, age, growth and relative condition of principal fish species). Samples were usually taken annually, with electrofishing primarily in spring and gill netting in fall. Seining was done in summer, however it was often excluded from sampling and these data were only available for a few years in certain reservoirs. The revised 1985 plan for standardized sampling indicated that, "seining should be conducted in instances where YOY information is needed..." (GA-DNR 1985). Thus, from 1985 on, seining was not consistently carried out. This de-emphasis of seining as a sampling technique was reiterated in the 1991 revision of sampling procedures: "Seining may be conducted..." (GA-DNR 1991). Electrofishing and gillnetting remained the major sampling efforts for Georgia reservoirs.

Table 3
Number of Years of Available Data (Period of Record)

Reservoir	Electrofishing		Gillnetting		Rotenone (Summer)	Seine (Summer)	Primary Source[1]
	Spring	Fall	Spring	Fall			
ACF System							
Lanier	3(86-92)	3(86-88)	—	3(86-88)	8(61-68)	—	GA DNR
West Point	10(77-89)	13(77-92)	—	13(78-92)	8(75-84)	4(82-89)	GA DNR
Bart. Ferry	8(87-94)	—	—	8(87-94)	2(77,83)		GA DNR
Goat Rock					1(80)		GA DNR
Worth					3(80-88)		GA DNR
Oliver	1(89)	—	—	1(89)	1(80)		GA DNR
W. F. George	9(86-94)	1(90)	—	13(76-94)	13(63-92)	4(87-90)	GA DNR
G. W. Andrews					1(80)		GA DNR
Blackshear	5(90-94)	—	—	5(90-94)	6(74-86)		GA DNR
Seminole	11(75-94)	1(90)	—	16(75-94)	5(77-85)	2(75,85)	GA DNR
ACT System							
Carter's	8(83-92)	6(87-92)	8(83-92)	4(89-92)	4(76-85)		GA DNR
Allatoona	10(81-94)	4(88-91)	10(81-94)	6(88-94)	8(51-86)		GA DNR
Weiss	1(87)	—	—	1(87)		1(87)	AL G&F
Neely-Henry	1(88)	—	—	1(88)		1(88)	AL G&F
Logan-Martin	3(83-88)	—	—	2(86,88)		2(86,88)	AL G&F
Lay	4(84-92)	—	—	2(87,92)		1(87)	AL G&F
Mitchell	3(87-91)	—	—	3(87-91)			AL G&F
Jordan	4(84-92)	—	—	3(87-92)	2(72,73)		AL G&F
Martin	5(88-92)	1(89)	—	4(88-92)		4(88-92)	AL G&F
Jones Bluff	4(86-93)	—	—	4(86-93)			AL G&F
Miller's Ferry							AL G&F
Claiborne							AL G&F

[1] See Table 4 for a full list of agencies and offices contacted.

Table 4
List of People Contacted for Fishery Data by River Basin and Reservoir

Reservoir	Contact
	ACF
Lake Lanier	GA DNR (Oda Weaver)
West Point	GA DNR (Jimmy Evans, Wayne Probst); ACOE-Mobile (Diane Findley); GA (R. Sosebee); AL G&F (Dan Catchings); Auburn Univ. (Mike Maceina, Bill Davies)
Bartlett's Ferry	GA DNR (Lee Keefer, Frank Ellis, Paul Loska); AL G&F (Jim McHugh); Auburn (Mike Maceina, Dennis DeVries)
Goat Rock	GA DNR (Lee Keefer); AL G&F (Jim McHugh)
Lake Worth	GA DNR (Lee Keefer)
Lake Oliver	GA DNR (Lee Keefer); AL G&F (Jim McHugh)
Walter F. George	GA DNR (Lee Keefer, Paul Loska)
G. W. Andrews	GA DNR (Lee Keefer)
Blackshear	GA DNR (Lee Keefer)
Seminole	GA DNR (Lee Keefer)
	ACT
Carters	GA DNR (Wayne Probst, Don Dennerline, Kevin Dallmier, Gary Beisser)
Allatoona	GA DNR (Wayne Probst, Don Dennerline, Kevin Dallmier, Gary Beisser)
Weiss	AL G&F (Dan Catchings); Auburn (Mike Maceina and Dennis DeVries)
Neeley-Henry	AL G&F (Dan Catchings)
Logan-Martin	AL G&F (Dan Catchings)
Lay	AL G&F (Dan Catchings); Auburn (Mike Maceina and Dennis DeVries)
Mitchell	AL G&F (Dan Catchings, Jim McHugh)
Jordan	AL G&F (Jim McHugh)
R. L. Harris	AL G&F (Dan Catchings); Auburn (Bill Davies, Mike Maceina and Dennis DeVries)
Martin	AL G&F (Dan Catchings, Jim McHugh); Auburn (Mike Maceina and Dennis DeVries)
Yates & Thurlow	AL G&F (Jim McHugh)
Jones Bluff	AL G&F (Jim McHugh); Auburn (Mike Maceina)
Miller's Ferry	AL G&F (Bill Tucker)
Claiborne	AL G&F (Bill Tucker)

Abbreviations are as follows: GA = Georgia, DNR = Department of Natural Resources, AL = Alabama, and G&F = Game and Fish.

Of the major reservoirs in the ACF basin, only West Point, Bartlett's Ferry, Walter F. George, Blackshear, and Seminole had sufficient fisheries data from standardized sampling. Lake Seminole was excluded because of extensive coverage by aquatic weeds, which might mask effects of hydrology (Lee Keefer, pers. comm.). Lake Blackshear and Bartlett's Ferry also were eliminated because hydrological data were not provided by private utilities. West Point and Walter F. George reservoirs, which are described in Table 5, were the only impoundments retained for data analysis.

Information on ACT reservoirs was not as abundant or available as for ACF impoundments. Standardized sampling was rarely conducted in consecutive years for Alabama reservoirs (Table 3). The Georgia DNR had adequate data on Allatoona and Carters reservoirs, which are described in Table 5.

Table 5
Description of Reservoirs Selected for Further Study

Reservoir	Description
Carter's	A U.S. Army Corps of Engineers mainstream impoundment of the Coosawattee River in northwest Georgia and part of the Alabama-Coosa-Tallapoosa drainage. Carter's Reservoir was formed in 1975 for the primary purposes of flood control, hydropower generation, and recreation. It is maintained at 327 m above mean sea level (MSL) and has a normal pool surface area of 1304 ha with 99.5 km of shoreline (Beisser, 1987). Its storage ratio of 0.42 years (> 0.165 years) would classify it as a hydropower storage reservoir.
Allatoona	A U.S. Army Corps of Engineers mainstream impoundment of the Etowah River in northwest Georgia and part of the Alabama-Coosa-Tallapoosa drainage. Allatoona Reservoir was formed in 1949 for the primary purposes of flood control, hydropower generation, and recreation. It is maintained at 256 m above MSL and has a normal pool surface area of 4,802 ha with 435 km of shoreline (Beisser, 1989). Its storage ratio of 0.3 years (> 0.165 years) would classify it as a hydropower storage reservoir.
West Point	A U.S. Army Corps of Engineers mainstream impoundment of the Chattahoochee River, running along the Georgia-Alabama border between West Point and Franklin, GA. Impoundment was completed in October 1974, and full-pool was established by May 1975. It is currently maintained at 193.5 m above MSL. At full summer pool, the reservoir occupies 10,482 ha with a volume of 745.4 million m^3 and has a shoreline length of 845 km. The maximum depth is 27 m with a mean of 7.1 m. The primary function of the reservoir is for flood control, hydropower generation, and recreation. (Timmons, et al 1978; Miranda, et al 1984). Its storage ratio (mean volume / total annual discharge) of 0.12 years (< 0.165 years) would be classified as hydropower mainstream.
Walter F. George	A U.S. Army Corps of Engineers mainstream impoundment of the Chattahoochee River, running along the Georgia-Alabama border between Ft. Gains and Columbus, GA. It was created in 1962, primarily for navigation and power generation. Maintained at 58 m above MSL, it occupies 1030 km of shoreline with a surface area of 18499 ha and a storage capacity of 1152.1 million m^3. During a winter draw down of 2 m, the pool lowers to 15,296 ha. The maximum depth is 29 m with a mean of 6.2 m. This reservoir has a cyclical history of fish kills, presumably caused by bacterial infections (Paul Loska, personal communication). Its storage ratio of 0.13 years (< 0.165 years) would classify it as a hydropower mainstream reservoir.

After reviewing a summary of available information, the Technical Coordination Group (TCG), Tri-state Comprehensive Study, failed to reach a concensus on the need for collecting additional data from Alabama and stopped funding this study. In spite of this constraint, we were able to do a limited analysis of effects of hydrology on black-bass reproductive success for the four reservoirs described in Table 5. Correlation matrices and single-variable regressions for those reservoirs are shown in Appendices A, B, C, and D to demonstrate the relative consistency of results among the four impoundments. Hopefully, these results will prove useful to qualitative modeling efforts funded by the TCG.

Results for Allatoona reservoir (Appendix A) indicate that the standing crop of age-0 spotted bass was positively correlated with mean area, perimeter area, and mean volume from June through August. The fall electrofishing catch of age-0 spotted bass also was positively correlated with mean volume, mean area, and perimeter area from June through August. The standing crop of age-1 spotted bass was positively correlated with previous year's mean volume (January-August), and change in area from summer to summer in over 1 or 2 prior years. We also found significant correlations of age-1 largemouth bass standing crop with mean volume (January-August) and change in area from summer to summer over 1 or 2 prior years.

We found positive correlations of fall electrofishing catches of age-0 spotted bass with changes in area from summer to spring and summer to summer (Appendix B). Spring electrofishing catches of age-1 spotted bass were positively correlated with ratio of inflow to release from January through August of the previous year. Insufficient years of cove-rotenone data were available for analysis.

Results for West Point Reservoir (Appendix C) included positive correlations between the standing crop of age-0 spotted bass and mean volume, perimeter area, and mean area from March through May. It was inversely correlated with summer flushing rate and release but positively correlated with the ratio of inflow to release from January through August. The standing crop of age-1 spotted bass was postively correlated with many area and flow-related variables in the previous year (Appendix C). The standing crop of age-0 largemouth bass was inversely correlated with June through August change in area, which usually was a drawdown. It was positively correlated with the ratio of inflow to release from June through August. The standing crop of age-1 largemouth bass was positively correlated with the previous year's ratio of inflow to release (June-August), March-May perimeter area and volume, and inversely correlated with change in area in summer. Spring electrofishing catch data for age-1 largemouth bass showed positive correlations with flushing rate, sum of releases, and sum of inflows from June through August of the previous year.

Results for Walter F. George Reservoir (Appendix D) included positive correlations of standing crops of age-1 largemouth bass with the previous year change in area from summer to spring and with previous year's mean volume, mean area, and perimeter area in spring (March-May). Similarly, spring

electrofishing catches of age-1 largemouth bass were positively correlated with mean volume, perimeter area, sum of releases, and sum of inflows in spring.

4 Discussion

Although specific hydrologic variables that were significantly correlated with catches of young black bass varied somewhat among impoundments, we found concordant trends consistent with published accounts, as described in the introduction of this report. There were two exceptions to expected relations described in the literature. First, standing crop of age-0 largemouth bass in cove rotenone samples from Walter F. George was inversely correlated with water-exchange variables in the same year. In contrast, biomass of age-1 largemouth bass was positively correlated with volume and area variables in the previous year (Appendix D). Volume, area, and water exchange variables usually are positively correlated. This apparent contradiction may result from less efficient sampling of age-0 largemouth bass in wet years than in dry years in this mainstream impoundment. Nevertheless, wet years appeared to produce above-average standing crops of age-1 largemouth bass the next year. These age-1 bass must originate from the reservoir or river upstream or both. Second, spring electrofishing catch of age-1 spotted bass in Allatoona Reservoir did not correlate with hydrologic variables in the previous year, although positive correlations were obtained for age-1 spotted bass in cove-rotenone samples with hydrology in the previous year. Age-0 spotted bass in rotenone and fall electrofishing samples were positively correlated with current-year hydrologic variables (Appendix A). March and April electrofishing, as conducted in Allatoona Reservoir, can provide highly variable estimates of age-1 relative abundance among years, depending upon time of sampling. Houser and Rainwater (1975) observed that annual population estimates taken before late May underestimated numbers of age-1 largemouth bass because older bass moved toward shore earlier and dispersed earlier than younger bass. Also, variation in inshore and offshore movements in early spring (a function of variations in weather) may increase the variability of estimates among years. They concluded that the optimum time for sampling largemouth bass was when movement was least and all age groups reached their greatest density in coves, usually in early June.

Weaknesses in this study include a shortage of fisheries data collected with consistent methods in consecutive years and the estimation of age from length-frequency distributions. The data shortage should be remedied as standardized sampling programs in both states mature. Long-term data collection with consistent methods is important provided details of possible sampling biases are understood. A paucity of age information in historical data sets is common, but

it does not preclude a search for empirical relations. Inaccurate assignment of catch among age classes can hinder detection of less robust relations between reproductive success and hydrology. A stunted population of older fish in a reservoir could suggest exceptional reproduction every year if ages were determined solely from length-frequency data. A few years of length-at-age data or a single study of age and growth may be sufficient to identify this problem. Our age classification based upon length-frequency data apparently was reasonable, and many age-0 bass must recruit, at least in wet years, because we obtained concordant results for "age-0" and "age-1" bass with the hydrology in the year each cohort was produced. Many fishery biologists rightfully express concern over the use of age-0 catch estimates for indexing reproductive success. High production of age-0 bass does not always translate to high recruitment (Miranda et al 1984). Although this is true, high age-0 production in spring and summer is a prerequisite for a strong year class, and limited age-0 production ensures a weak year class, regardless of over-winter survival. The summer abundance of age-0 bass is a timely indicator that allows managers to do something to improve survival and facilitate development of a strong year class. For example, they might request maintenance of above average pool levels through winter. It is important to determine the factors that lead to extremes in age-0 bass production, as well as in recruitment to age-1.

A productive strategy of water-level management would consist of assuring high water and acceptable habitat after an acceptably wet spring, because the most important variable affecting production of strong year classes appears to be post-spawning survival of age-0 fish. We could not determine from correlations the relative importance of high inflow versus inundation of terrestrial vegetation for producing strong year classes of largemouth and spotted bass. Both factors may be critical. Flooding of terrestrial vegetation in a year of average inflow probably is not as effective for increasing largemouth and spotted bass growth and recruitment as is inundation of vegetation in a year of naturally high inflow and nutrient loading (Strange et al. 1982; Miranda et al. 1984).

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Appendix A
Lake Allatoona Correlation and Regression Results

APPENDIX A. Lake Allatoona correlation and regression results based upon cove-rotenone sampling and spring electrofishing. Definitions of hydrologic variables are presented in Table 2. Fishery variables are defined in the correlation section.

APPENDIX A: LAKE ALLATOONA (COVE ROTENONE SAMPLING)

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
SSB_KGHA	7	0.7352	0.1839	5.1465	0.4940	0.9519
ISB_KGHA	7	0.7331	0.3110	5.1315	0.1402	1.0729
NYISB	7	0.7331	0.3110	5.1315	0.1402	1.0729
SLM_KGHA	7	0.7820	0.1506	5.4740	0.4617	0.9304
ILM_KGHA	7	1.0432	0.2846	7.3023	0.4247	1.2755
NYILMB	7	1.0432	0.2846	7.3023	0.4247	1.2755
XVOL1_8	42	2.6235	0.0353	110.1861	2.4743	2.6719
XCMS1_8	42	1.5265	0.1299	64.1135	1.2142	1.7428
SINF1_8	42	3.0313	0.1591	127.3134	2.5730	3.3283
SREL1_8	42	3.0821	0.1513	129.4467	2.5666	3.3708
FR1_8	42	2.1744	0.0457	91.3232	2.0373	2.2616
RIR1_8	42	1.9834	0.0106	83.3038	1.9617	2.0137
XVOL9_11	41	2.5775	0.0523	105.6787	2.3962	2.6586
SINF9_11	41	2.4746	0.1637	101.4576	1.9800	2.8546
SREL9_11	41	2.2765	0.2104	93.3359	1.7378	2.7552
FR9_11	41	0.8824	0.0700	36.1778	0.6898	1.0363
RIR9_11	41	1.0916	0.0724	44.7569	0.8609	1.2976
XA9_11	41	3.6071	0.0431	147.8902	3.4649	3.6783
PA9_11	41	3.2610	0.0214	133.6997	3.1908	3.2966
CA9_11	41	0.0519	0.1191	2.1261	-0.2932	0.2399
XVOL3_5	42	2.6586	0.0437	111.6619	2.5071	2.7657
SINF3_5	42	2.6693	0.2318	112.1115	1.9845	3.1323
SREL3_5	42	2.7637	0.1796	116.0738	2.2850	3.1736
FR3_5	42	1.0389	0.0539	43.6321	0.8985	1.1475
RIR3_5	42	0.9646	0.0301	40.5143	0.8496	1.0358
XA3_5	42	3.6760	0.0382	154.3940	3.5471	3.7726
PA3_5	42	3.2955	0.0192	138.4096	3.2311	3.3442
CA3_5	42	0.0528	0.1178	2.2165	-0.2932	0.2399
CASUSP	41	0.008285	0.1105	0.3397	-0.2731	0.4514
CASUSP2	41	0.0166	0.2209	0.6795	-0.5462	0.9027
XVOL6_8	42	2.6582	0.0402	111.6456	2.4678	2.7029
SINF6_8	42	2.4693	0.1406	103.7120	2.0237	2.7611
SREL6_8	42	2.3631	0.2199	99.2483	1.6770	2.7783
FR6_8	42	0.8882	0.0738	37.3037	0.6485	1.0312
RIR6_8	42	1.0495	0.0563	44.0787	0.9750	1.2807
XA6_8	42	3.6747	0.0340	154.3369	3.5151	3.7133
PA6_8	42	3.2948	0.0170	138.3815	3.2154	3.3142
CA6_8	42	-7.1414	5.9744	-299.9392	-17.4872	13.7874
CASUSU	41	0.6845	10.2536	28.0651	-32.4829	46.8427
CASUSU2	41	1.3690	20.5073	56.1304	-64.9658	93.6854

APPENDIX A: LAKE ALLATOONA (COVE ROTENONE SAMPLING)
Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

SSB_KGHA = LOG(KG/HA + 1) OF AGE-0 SPOTTED BASS WITH CURRENT YEAR HYDROLOGY EXCEPT 9_11 VARIABLES WHICH ARE PREVIOUS YEAR

XA6_8	PA6_8	XVOL6_8	XVOL9_11	XA9_11	PA9_11	XA3_5
0.90638	0.90557	0.90365	0.86838	0.86497	0.86397	0.49510
0.0127	0.0130	0.0135	0.0562	0.0583	0.0590	0.3180
6	6	6	5	5	5	6

PA3_5	XVOL3_5	SREL9_11	SINF9_11	CA6_8	CASUSP2	CASUSP
0.49358	0.48791	0.48554	0.47394	-0.40219	0.39828	0.39811
0.3198	0.3262	0.4070	0.4200	0.4292	0.5066	0.5068
6	6	5	5	6	5	5

XVOL1_8	FR9_11	RIR1_8	SINF6_8	RIR3_5	SREL1_8
0.35979	0.34555	-0.31281	0.30978	-0.29054	0.28936
0.4836	0.5690	0.5461	0.5502	0.5765	0.5781
6	5	6	6	6	6

NYISB = LOG(KG/HA + 1) OF AGE-1 SPOTTED BASS WITH PREVIOUS YEAR'S HYDROLOGY

XVOL1_8	CASUSU	CASUSU2	CA6_8	CASUSP2	CASUSP	RIR6_8
0.92760	0.91342	0.91342	0.81797	0.78952	0.78950	-0.75755
0.0231	0.0302	0.0302	0.0906	0.1122	0.1122	0.1380
5	5	5	5	5	5	5

CA9_11	XVOL6_8	XA6_8	PA6_8	SREL1_8	RIR9_11	XVOL3_5
0.75312	0.72335	0.72295	0.72160	0.71775	0.67917	0.64023
0.1417	0.1672	0.1676	0.1688	0.1722	0.2073	0.2446
5	5	5	5	5	5	5

XA3_5	PA3_5	XCMS1_8	XVOL9_11	XA9_11	PA9_11
0.62954	0.62831	0.61931	-0.60806	-0.60699	-0.60575
0.2551	0.2563	0.2653	0.2766	0.2777	0.2789
5	5	5	5	5	5

NYILMB = LOG(KG/HA + 1) OF AGE-1 LARGEMOUTH BASS WITH PREVIOUS YEAR'S HYDROLOGY

XVOL1_8	CASUSU	CASUSU2	CA6_8	RIR6_8	SREL1_8	XVOL6_8
0.90952	0.90024	0.90024	0.85931	-0.85282	0.80841	0.78653
0.0322	0.0373	0.0373	0.0620	0.0663	0.0977	0.1145
5	5	5	5	5	5	5

XA6_8	PA6_8	CASUSP2	CASUSP	FR1_8	XCMS1_8	SREL6_8
0.78437	0.78359	0.74886	0.74882	0.72641	0.68218	0.67190
0.1162	0.1168	0.1453	0.1453	0.1646	0.2045	0.2141
5	5	5	5	5	5	5

FR6_8	SINF1_8	XVOL3_5	XA3_5	PA3_5	CA9_11
0.65071	0.64612	0.63764	0.62739	0.62574	0.59411
0.2344	0.2388	0.2471	0.2572	0.2589	0.2908
5	5	5	5	5	5

APPENDIX A: LAKE ALLATOONA (COVE ROTENONE SAMPLING)

SSB_KGHA = LOG(KG/HA + 1) OF AGE-0 SPOTTED BASS VS. MEAN AREA (JUN-AUG)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.11096	0.11096	18.411	0.0127
Error	4	0.02411	0.00603		
C Total	5	0.13507			

Root MSE	0.07763	R-square	0.8215
Dep Mean	0.77542	Adj R-sq	0.7769
C.V.	10.01162		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-31.297851	7.47494706	-4.187	0.0138
XA6_8	1	8.727026	2.03388868	4.291	0.0127

SSB_KGHA = LOG(KG/HA + 1) - AGE-0 SPOTTED BASS VS. PREVIOUS FALL MEAN AREA (SEP-NOV)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.03675	0.03675	8.913	0.0583
Error	3	0.01237	0.00412		
C Total	4	0.04912			

Root MSE	0.06421	R-square	0.7482
Dep Mean	0.82895	Adj R-sq	0.6642
C.V.	7.74629		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-11.311624	4.06673751	-2.781	0.0689
XA9_11	1	3.349845	1.12207209	2.985	0.0583

APPENDIX A: LAKE ALLATOONA (COVE ROTENONE SAMPLING)

LOG(KG/HA + 1) - AGE-1 SPOTTED BASS VS. PREVIOUS YEAR'S MEAN VOLUME (JAN-AUG)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.07399	0.07399	18.495	0.0231
Error	3	0.01200	0.00400		
C Total	4	0.08599			

Root MSE	0.06325	R-square	0.8604
Dep Mean	0.88484	Adj R-sq	0.8139
C.V.	7.14811		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-10.786350	2.71400373	-3.974	0.0285
XVOL1_8	1	4.416056	1.02684790	4.301	0.0231

Dependent Variable: NYISB = LOG(KG/HA + 1) OF AGE-1 SPOTTED BASS WITH PREVIOUS YEAR'S HYDROLOGY VS. AREA CHANGE (SUMMER TO SUMMER)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.07175	0.07175	15.110	0.0302
Error	3	0.01424	0.00475		
C Total	4	0.08599			

Root MSE	0.06891	R-square	0.8343
Dep Mean	0.88484	Adj R-sq	0.7791
C.V.	7.78759		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	0.791471	0.03907264	20.256	0.0003
CASUSU	1	0.050536	0.01300076	3.887	0.0302

APPENDIX A: LAKE ALLATOONA (SPRING ELECTROFISHING)

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
F_SSB	6	1.3289	0.3256	7.9736	0.7402	1.6658
XVOL1_8	42	2.6235	0.0353	110.1861	2.4743	2.6719
XCMS1_8	42	1.5265	0.1299	64.1135	1.2142	1.7428
SINF1_8	42	3.0313	0.1591	127.3134	2.5730	3.3283
SREL1_8	42	3.0821	0.1513	129.4467	2.5666	3.3708
FR1_8	42	2.1744	0.0457	91.3232	2.0373	2.2616
RIR1_8	42	1.9834	0.0106	83.3038	1.9617	2.0137
XVOL9_11	41	2.5775	0.0523	105.6787	2.3962	2.6586
SINF9_11	41	2.4746	0.1637	101.4576	1.9800	2.8546
SREL9_11	41	2.2765	0.2104	93.3359	1.7378	2.7552
FR9_11	41	0.8824	0.0700	36.1778	0.6898	1.0363
RIR9_11	41	1.0916	0.0724	44.7569	0.8609	1.2976
XA9_11	41	3.6071	0.0431	147.8902	3.4649	3.6783
PA9_11	41	3.2610	0.0214	133.6997	3.1908	3.2966
CA9_11	41	0.0519	0.1191	2.1261	-0.2932	0.2399
XVOL3_5	42	2.6586	0.0437	111.6619	2.5071	2.7657
SINF3_5	42	2.6693	0.2318	112.1115	1.9845	3.1323
SREL3_5	42	2.7637	0.1796	116.0738	2.2850	3.1736
FR3_5	42	1.0389	0.0539	43.6321	0.8985	1.1475
RIR3_5	42	0.9646	0.0301	40.5143	0.8496	1.0358
XA3_5	42	3.6760	0.0382	154.3940	3.5471	3.7726
PA3_5	42	3.2955	0.0192	138.4096	3.2311	3.3442
CA3_5	42	0.0528	0.1178	2.2165	-0.2932	0.2399
CASUSP	41	0.008285	0.1105	0.3397	-0.2731	0.4514
CASUSP2	41	0.0166	0.2209	0.6795	-0.5462	0.9027
XVOL6_8	42	2.6582	0.0402	111.6456	2.4678	2.7029
SINF6_8	42	2.4693	0.1406	103.7120	2.0237	2.7611
SREL6_8	42	2.3631	0.2199	99.2483	1.6770	2.7783
FR6_8	42	0.8882	0.0738	37.3037	0.6485	1.0312
RIR6_8	42	1.0495	0.0563	44.0787	0.9750	1.2807
XA6_8	42	3.6747	0.0340	154.3369	3.5151	3.7133
PA6_8	42	3.2948	0.0170	138.3815	3.2154	3.3142
CA6_8	42	-7.1414	5.9744	-299.9392	-17.4872	13.7874
CASUSU	41	0.6845	10.2536	28.0651	-32.4829	46.8427
CASUSU2	41	1.3690	20.5073	56.1304	-64.9658	93.6854

Correlation Analysis

F_SSB = LOG(AGE-0 SPOTTED BASS CATCH + 1)

XVOL6_8	XA6_8	PA6_8	CASUSU2	CASUSU	XVOL1_8	RIR1_8
0.89436	0.89404	0.89383	0.83242	0.83242	0.79592	-0.76125
0.0161	0.0162	0.0163	0.0398	0.0398	0.0582	0.0787
6	6	6	6	6	6	6

SINF6_8	CASUSP2	CASUSP	XVOL3_5	XA3_5	PA3_5	PA9_11
0.75584	0.73188	0.73177	0.68614	0.67812	0.67605	-0.65604
0.0821	0.0982	0.0983	0.1323	0.1387	0.1404	0.1571
6	6	6	6	6	6	6

NO SIGNIFICANT CORRELATIONS OF AGE-1 SPOTTED BASS CATCH WITH PREVIOUS YEAR'S HYDROLOGY

APPENDIX A: LAKE ALLATOONA (SPRING ELECTROFISHING)

Dependent Variable: F_SSB = LOG(CATCH + 1) OF AGE-0 SPOTTED BASS IN FALL VS. MEAN VOLUME (JUN-AUG)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.42411	0.42411	15.988	0.0161
Error	4	0.10610	0.02653		
C Total	5	0.53021			

Root MSE	0.16287	R-square	0.7999
Dep Mean	1.32894	Adj R-sq	0.7499
C.V.	12.25541		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-7.424101	2.19005703	-3.390	0.0275
XVOL6_8	1	3.321228	0.83060570	3.999	0.0161

Dependent Variable: F_SSB = LOG(CATCH + 1) OF AGE-0 SPOTTED BASS IN FALL VS. MEAN VOLUME (JUN-AUG)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.42380	0.42380	15.931	0.0162
Error	4	0.10641	0.02660		
C Total	5	0.53021			

Root MSE	0.16310	R-square	0.7993
Dep Mean	1.32894	Adj R-sq	0.7491
C.V.	12.27315		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-13.089128	3.61295508	-3.623	0.0223
XA6_8	1	3.943817	0.98809442	3.991	0.0162

Appendix B
Carter's Reservoir Correlation and Regression Results

APPENDIX B. Carter's Reservoir correlation and regression results based upon electrofishing. Definitions of hydrologic variables are presented in Table 2. Fishery variables (N = 7) are defined in the correlation section.

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
NYISB	8	0.6634	0.3812	5.3070	0.0477	1.1409
TYSSB	5	1.2506	0.2435	6.2528	0.9284	1.6013
XVOL1_8	24	2.6725	0.005468	64.1411	2.6647	2.6827
XCMS1_8	24	1.3619	0.1758	32.6856	0.8504	1.6424
SINF1_8	24	2.6518	0.3030	63.6432	1.7600	2.9829
SREL1_8	24	2.6567	0.2970	63.7608	1.7505	2.9740
FR1_8	24	1.9940	0.1100	47.8550	1.6555	2.1086
RIR1_8	24	1.9980	0.0160	47.9517	1.9594	2.0375
XVOL9_11	23	2.6555	0.0211	61.0756	2.6061	2.6788
SINF9_11	23	1.9635	0.2448	45.1606	1.5665	2.3294
SREL9_11	23	1.9232	0.2658	44.2345	1.3046	2.3229
FR9_11	23	0.7239	0.0972	16.6487	0.4970	0.8671
RIR9_11	23	1.0291	0.1159	23.6703	0.8943	1.3332
XA9_11	23	3.0986	0.0183	71.2683	3.0560	3.1189
PA9_11	23	2.2362	0.0109	51.4320	2.2106	2.2482
CA9_11	22	-0.005155	0.0358	-0.1134	-0.1159	0.0431
XVOL3_5	23	2.6774	0.007740	61.5796	2.6664	2.6939
SINF3_5	23	2.3766	0.2671	54.6625	1.8609	2.7229
SREL3_5	23	2.3783	0.2499	54.7001	1.9252	2.7225
FR3_5	23	0.8881	0.0918	20.4273	0.7204	1.0161
RIR3_5	23	0.9985	0.0160	22.9665	0.9563	1.0160
XA3_5	23	3.1176	0.006755	71.7040	3.1081	3.1322
PA3_5	23	2.2475	0.004001	51.6920	2.2418	2.2561
CA3_5	23	-0.005313	0.0353	-0.1222	-0.1159	0.0431
CASUSP	23	0.0139	0.0154	0.3187	-0.006400	0.0539
CASUSP2	23	0.0277	0.0308	0.6380	-0.0128	0.1077
XVOL6_8	24	2.6714	0.006217	64.1128	2.6608	2.6839
SINF6_8	24	2.0708	0.2288	49.6986	1.6433	2.4206
SREL6_8	24	1.9873	0.3222	47.6940	1.3076	2.3751
FR6_8	24	0.7437	0.1194	17.8489	0.4910	0.8853
RIR6_8	24	1.0543	0.0923	25.3034	0.9927	1.3325
XA6_8	24	2.6184	1.1315	62.8419	0	3.1232
PA6_8	24	2.2444	0.003189	53.8650	2.2390	2.2508
CA6_8	23	-2.4011	2.2614	-55.2252	-6.5902	0.9683
CASUSU	23	0.1859	1.7800	4.2763	-2.4186	4.2216
CASUSU2	23	0.3719	3.5599	8.5529	-4.8371	8.4433

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0

TYSSB = LOG(AGE-0 SPOTTED BASS CATCH + 1) BASED UPON FALL ELECTROFISHING

CASUSU2	CASUSU	CASUSP2	CASUSP	SINF9_11	XVOL6_8	PA6_8
0.96865	0.96865	0.88373	0.88301	-0.71504	0.66093	0.66035
0.0066	0.0066	0.0468	0.0472	0.1746	0.2246	0.2251
5	5	5	5	5	5	5

CARTERS RESERVOIR (ELECTROFISHING)

NYISB = LOG(NEXT YEAR'S INTERMEDIATE SPOTTED BASS CATCH + 1) WITH PREVIOUS YEAR'S HYDROLOGY

RIR1_8	RIR3_5	RIR9_11	CA9_11	FR9_11	SREL9_11	SINF3_5
0.75447	0.66144	-0.50491	-0.50239	0.41653	0.39808	0.29290
0.0305	0.0741	0.2019	0.2045	0.3046	0.3287	0.4814
8	8	8	8	8	8	8

Dependent Variable: TYSSB = LOG(CATCH + 1) OF AGE-0 SPOTTED BASS IN FALL VS. CHANGE IN AREA FROM SUMMER TO SUMMER

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.22249	0.22249	45.606	0.0066
Error	3	0.01464	0.00488		
C Total	4	0.23713			

Root MSE	0.06985	R-square	0.9383
Dep Mean	1.25056	Adj R-sq	0.9177
C.V.	5.58524		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	1.174405	0.03320946	35.364	0.0001
CASUSU	1	0.091860	0.01360240	6.753	0.0066

Dependent Variable: NYISB = LOG(CATCH + 1) OF AGE-1 SPOTTED BASS IN SPRING VS. THE RATIO OF INFLOW TO RELEASE FROM JAN-AUG OF THE PREVIOUS YEAR

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.40137	0.40137	3.168	0.1731
Error	3	0.38003	0.12668		
C Total	4	0.78140			

Root MSE	0.35592	R-square	0.5137
Dep Mean	0.64470	Adj R-sq	0.3515
C.V.	55.20679		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-30.250366	17.35738682	-1.743	0.1797
RIR1_8	1	15.496811	8.70601362	1.780	0.1731

Appendix C
West Point Reservoir Correlation and Regression Results

APPENDIX C. West Point Reservoir correlation and regression results based upon cove-rotenone sampling and spring electrofishing. Definitions of hydrologic variables are presented in Table 2. Fishery variables (N=7) are defined in the correlation section.

APPENDIX C: WEST POINT LAKE (COVE-ROTENONE SAMPLING)

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
SSB_KGHA	7	0.163093	0.015588	1.141653	0.134918	0.178670
ISB_KGHA	7	0.236643	0.011849	1.656503	0.219298	0.243581
NYISB	7	0.236643	0.011849	1.656503	0.219298	0.243581
SLM_KGHA	7	1.326378	0.088054	9.284646	1.200057	1.437281
ILM_KGHA	7	1.250287	0.073191	8.752011	1.131423	1.339797
NYILMB	7	1.250287	0.073191	8.752011	1.131423	1.339797
XVOL1_8	19	2.822800	0.026062	53.633200	2.748400	2.863500
XCMS1_8	19	2.012153	0.159499	38.230900	1.708200	2.247400
SINF1_8	19	3.465963	0.182634	65.853300	3.099700	3.713700
SREL1_8	19	3.487705	0.171816	66.266400	3.175600	3.722100
FR1_8	19	2.235426	0.057127	42.473100	2.111100	2.317400
RIR1_8	19	1.993611	0.006818	37.878600	1.974300	2.002000
XVOL9_11	18	2.772811	0.074754	49.910600	2.604200	2.865600
SINF9_11	18	2.934528	0.138360	52.821500	2.656500	3.145000
SREL9_11	18	2.893606	0.132478	52.084900	2.730100	3.141500
FR9_11	18	1.043361	0.031418	18.780500	0.988100	1.098300
RIR9_11	18	1.014339	0.024519	18.258100	0.953500	1.054700
XA9_11	18	3.944750	0.051525	71.005500	3.831500	4.010100
PA9_11	18	3.662611	0.040450	65.927000	3.570700	3.712700
CA9_11	17	0.127259	0.093654	2.163400	-0.087100	0.304600
XVOL3_5	19	2.835695	0.019196	53.878200	2.777500	2.862900
SINF3_5	19	3.037737	0.312694	57.717000	2.209000	3.429900
SREL3_5	19	3.124174	0.239588	59.359300	2.631800	3.468600
FR3_5	19	1.101437	0.080286	20.927300	0.934900	1.217900
RIR3_5	19	0.970463	0.034935	18.438800	0.839400	0.992000
XA3_5	19	3.779953	0.915140	71.819100	0.001300	4.008600
PA3_5	19	3.697095	0.010415	70.244800	3.665600	3.711600
CA3_5	18	0.124761	0.091473	2.245700	-0.087100	0.304600
CASUSP	18	-0.025178	0.090056	-0.453200	-0.160800	0.256900
CASUSP2	18	-0.050344	0.180129	-0.906200	-0.321700	0.513800
XVOL6_8	19	2.853889	0.045013	54.223900	2.702300	2.893800
SINF6_8	19	2.968679	0.120740	56.404900	2.650900	3.127900
SREL6_8	19	2.906153	0.158241	55.216900	2.513600	3.106600
FR6_8	19	1.017889	0.044367	19.339900	0.899400	1.074600
RIR6_8	19	1.022405	0.021926	19.425700	0.988200	1.084200
XA6_8	19	4.002074	0.032130	76.039400	3.895200	4.031200
PA6_8	19	3.706505	0.024384	70.423600	3.624300	3.728000
CA6_8	19	-8.168574	9.206181	-155.202900	-28.684400	6.865000
CASUSU	18	0.370022	12.178725	6.660400	-23.216000	31.308700
CASUSU2	18	0.740072	24.357450	13.321300	-46.432000	62.617400

APPENDIX C: WEST POINT LAKE (COVE-ROTENONE SAMPLING)

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

SSB_KGHA = LOG(KG/HA + 1) OF AGE-0 SPOTTED BASS WITH CURRENT YEAR'S HYDROLOGY EXCEPT 9_11 VARIABLES WHICH ARE PREVIOUS YEAR

XVOL3_5	PA3_5	FR6_8	RIR1_8	SREL6_8	XA3_5	CA6_8
0.83508	0.82726	-0.82610	0.82336	-0.80560	0.79807	-0.75350
0.0194	0.0217	0.0220	0.0228	0.0287	0.0315	0.0505
7	7	7	7	7	7	7

RIR6_8	RIR3_5	SINF6_8	XVOL1_8	SINF9_11	SREL9_11	SINF3_5
0.72206	0.70950	-0.69798	-0.64099	-0.61361	-0.58264	0.54037
0.0669	0.0742	0.0812	0.1208	0.1951	0.2249	0.2105
7	7	7	7	6	6	7

PA9_11	XA9_11	XVOL9_11	SREL3_5	FR3_5	SINF1_8
-0.51734	-0.51733	-0.51511	0.45048	0.42972	0.40682
0.2932	0.2932	0.2957	0.3104	0.3359	0.3651
6	6	6	7	7	7

NYISB = LOG(KG/HA + 1) OF AGE-1 SPOTTED BASS WITH PREVIOUS YEAR'S HYDROLOGY

XA3_5	RIR3_5	RIR1_8	SINF3_5	FR1_8	SINF1_8	SREL1_8
0.99999	0.99425	0.98266	0.95619	0.94407	0.94307	0.93278
0.0001	0.0001	0.0004	0.0028	0.0046	0.0048	0.0066
6	6	6	6	6	6	6

SREL3_5	FR3_5	RIR6_8	PA3_5	XVOL1_8	XVOL3_5	CA6_8
0.92488	0.92304	0.84826	0.83418	-0.82996	0.82985	-0.67610
0.0083	0.0087	0.0328	0.0390	0.0409	0.0410	0.1404
6	6	6	6	6	6	6

XCMS1_8	SREL6_8	FR6_8	SINF6_8	XVOL6_8	PA6_8
0.54504	-0.49019	-0.46441	-0.22802	-0.20739	-0.19527
0.2634	0.3236	0.3535	0.6639	0.6934	0.7108
6	6	6	6	6	6

SLM_KGHA = LOG(KG/HA + 1) OF AGE-0 LARGEMOUTH BASS WITH CURRENT YEAR'S HYDROLOGY EXCEPT 9_11 VARIABLES WHICH ARE PREVIOUS YEAR

CA6_8	RIR6_8	FR6_8	XVOL3_5	PA3_5	RIR1_8	SREL6_8
-0.85015	0.76461	-0.74447	0.72805	0.72523	0.72286	-0.70520
0.0154	0.0453	0.0549	0.0636	0.0651	0.0664	0.0767
7	7	7	7	7	7	7

XA3_5	XVOL9_11	PA9_11	XA9_11	RIR3_5	SINF6_8	XVOL1_8
0.63381	-0.61572	-0.61494	-0.61056	0.54472	-0.48741	-0.44879
0.1264	0.1931	0.1939	0.1980	0.2061	0.2672	0.3125
7	6	6	6	7	7	7

SINF3_5	SREL9_11	SREL3_5	FR3_5	SINF9_11	SINF1_8
0.41721	-0.38736	0.34872	0.32859	-0.31928	0.30282
0.3517	0.4480	0.4433	0.4718	0.5374	0.5092
7	6	7	7	6	7

APPENDIX C: WEST POINT LAKE (COVE-ROTENONE SAMPLING)
Correlation Analysis

NYILMB = LOG(KG/HA + 1) OF AGE-1 LARGEMOUTH BASS WITH PREVIOUS YEAR'S HYDROLOGY

RIR6_8	PA3_5	XVOL3_5	CA6_8	RIR3_5	SINF3_5	RIR1_8
0.86573	0.84495	0.84480	-0.83630	0.71931	0.71589	0.71345
0.0258	0.0342	0.0343	0.0380	0.1071	0.1096	0.1114
6	6	6	6	6	6	6

XA3_5	SREL3_5	SINF1_8	SREL1_8	FR3_5	FR1_8	FR6_8
0.70777	0.70248	0.70069	0.69502	0.68889	0.65915	0.62508
0.1156	0.1196	0.1210	0.1253	0.1301	0.1545	0.1845
6	6	6	6	6	6	6

SREL6_8	RIR9_11	XCMS1_8	CA9_11	SINF6_8	XA6_8
-0.54503	0.40909	0.39067	0.37029	-0.29045	0.26444
0.2634	0.4941	0.4438	0.6297	0.5766	0.6126
6	5	6	4	6	6

Dependent Variable: SSB_KGHA = LOG(KG/HA + 1) OF AGE-0 SPOTTED BASS VS. MEAN VOLUME (MAR-MAY)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.00102	0.00102	11.521	0.0194
Error	5	0.00044	0.00009		
C Total	6	0.00146			

Root MSE	0.00939	R-square	0.6974
Dep Mean	0.16309	Adj R-sq	0.6368
C.V.	5.75980		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-2.855962	0.88947192	-3.211	0.0237
XVOL3_5	1	1.063936	0.31345358	3.394	0.0194

Dependent Variable: SSB_KGHA = LOG(KG/HA + 1) OF AGE-0 SPOTTED BASS VS. PERIMETER AREA (MAR-MAY)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.00100	0.00100	10.841	0.0217
Error	5	0.00046	0.00009		
C Total	6	0.00146			

Root MSE	0.00959	R-square	0.6844
Dep Mean	0.16309	Adj R-sq	0.6212
C.V.	5.88211		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-7.028770	2.18427826	-3.218	0.0235
PA3_5	1	1.944580	0.59059778	3.293	0.0217

APPENDIX C: WEST POINT LAKE (COVE-ROTENONE SAMPLING)

Dependent Variable: NYISB = LOG(KG/HA + 1) OF AGE-1 SPOTTED BASS WITH MEAN AREA (MAR-MAY) IN THE PREVIOUS YEAR

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.00049	0.00049	366318.584	0.0001
Error	4	5.3658717E-9	1.3414679E-9		
C Total	5	0.00049			

Root MSE	0.00004	R-square	1.0000
Dep Mean	0.23953	Adj R-sq	1.0000
C.V.	0.01529		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	0.219290	0.00003664	5985.351	0.0001
XA3_5	1	0.006082	0.00001005	605.243	0.0001

Dependent Variable: SLM_KGHA = LOG(KG/HA + 1) OF AGE-0 LARGEMOUTH BASS VS. CHANGE IN AREA (JUN-AUG)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.03362	0.03362	13.035	0.0154
Error	5	0.01290	0.00258		
C Total	6	0.04652			

Root MSE	0.05079	R-square	0.7228
Dep Mean	1.32638	Adj R-sq	0.6673
C.V.	3.82914		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	1.222509	0.03458583	35.347	0.0001
CA6_8	1	-0.008028	0.00222345	-3.610	0.0154

Dependent Variable: SLM_KGHA = SLM_KGHA = LOG(KG/HA + 1) OF AGE-0 LARGEMOUTH BASS VS. RATIO OF INFLOW TO RELEASE (JUN-AUG)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.02720	0.02720	7.037	0.0453
Error	5	0.01932	0.00386		
C Total	6	0.04652			

Root MSE	0.06217	R-square	0.5846
Dep Mean	1.32638	Adj R-sq	0.5016
C.V.	4.68699		

Parameter Estimates

Variable	DF	Estimate	Parameter Error	Standard Parameter=0	T for H0: Prob > |T|
INTERCEP	1	-1.299104	0.98998099	-1.312	0.2464
RIR6_8	1	2.552055	0.96202331	2.653	0.0453

APPENDIX C: WEST POINT LAKE (COVE-ROTENONE SAMPLING)
SMALL LMB VS. FLUSHING RATE (JUN-AUG)

Dependent Variable: SLM_KGHA = SLM_KGHA = LOG(KG/HA + 1) OF AGE-0 LARGEMOUTH BASS VS. FLUSHING RATE (JUN-AUG)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.02578	0.02578	6.217	0.0549
Error	5	0.02074	0.00415		
C Total	6	0.04652			

Root MSE	0.06440	R-square	0.5542
Dep Mean	1.32638	Adj R-sq	0.4651
C.V.	4.85540		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	2.990041	0.66768340	4.478	0.0065
FR6_8	1	-1.635142	0.65580052	-2.493	0.0549

Dependent Variable: NYILMB = LOG(KG/HA + 1) OF AGE-1 LARGEMOUTH BASS VS. RATIO OF INFLOW TO RELEASE (JUN-AUG)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.01174	0.01174	11.968	0.0258
Error	4	0.00392	0.00098		
C Total	5	0.01566			

Root MSE	0.03132	R-square	0.7495
Dep Mean	1.27010	Adj R-sq	0.6869
C.V.	2.46556		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-3.271081	1.31276209	-2.492	0.0674
RIR6_8	1	4.454174	1.28754970	3.459	0.0258

APPENDIX C: WEST POINT (SPRING ELECTROFISHING)

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
NYILMB	6	1.0355	0.1871	6.2132	0.7207	1.2283
XVOL1_8	21	2.8252	0.0258	59.3288	2.7484	2.8635
XCMS1_8	21	2.0198	0.1581	42.4153	1.7082	2.2474
SINF1_8	21	3.4739	0.1772	72.9524	3.0997	3.7137
SREL1_8	21	3.4951	0.1666	73.3964	3.1756	3.7221
FR1_8	21	2.2370	0.0551	46.9767	2.1111	2.3174
RIR1_8	21	1.9938	0.006520	41.8698	1.9743	2.0020
XVOL9_11	20	2.7647	0.0802	55.2932	2.6042	2.8656
SINF9_11	20	2.9223	0.1366	58.4468	2.6565	3.1450
SREL9_11	20	2.8885	0.1307	57.7708	2.7301	3.1415
FR9_11	20	1.0446	0.0300	20.8929	0.9881	1.0983
RIR9_11	20	1.0119	0.0255	20.2385	0.9535	1.0547
XA9_11	20	3.9392	0.0549	78.7843	3.8315	4.0101
PA9_11	20	3.6582	0.0435	73.1632	3.5707	3.7127
CA9_11	19	0.1250	0.0890	2.3748	-0.0871	0.3046
XVOL3_5	21	2.8361	0.0183	59.5575	2.7775	2.8629
SINF3_5	21	3.0460	0.3012	63.9658	2.2090	3.4299
SREL3_5	21	3.1306	0.2311	65.7421	2.6318	3.4686
FR3_5	21	1.1036	0.0776	23.1751	0.9349	1.2179
RIR3_5	21	0.9712	0.0334	20.3962	0.8394	0.9920
XA3_5	21	3.8001	0.8705	79.8026	0.001300	4.0086
PA3_5	21	3.6973	0.009908	77.6431	3.6656	3.7116
CA3_5	20	0.1310	0.0888	2.6204	-0.0871	0.3046
CASUSP	20	-0.0233	0.0860	-0.4660	-0.1608	0.2569
CASUSP2	20	-0.0466	0.1721	-0.9317	-0.3217	0.5138
XVOL6_8	21	2.8568	0.0437	59.9938	2.7023	2.8938
SINF6_8	21	2.9738	0.1204	62.4506	2.6509	3.1279
SREL6_8	21	2.9132	0.1561	61.1764	2.5136	3.1066
FR6_8	21	1.0193	0.0442	21.4056	0.8994	1.0746
RIR6_8	21	1.0217	0.0210	21.4550	0.9882	1.0842
XA6_8	21	4.0042	0.0312	84.0885	3.8952	4.0312
PA6_8	21	3.7081	0.0237	77.8701	3.6243	3.7280
CA6_8	21	-7.8792	8.8125	-165.4639	-28.6844	6.8650
CASUSU	20	1.0477	11.7566	20.9537	-23.2160	31.3087
CASUSU2	20	2.0954	23.5133	41.9080	-46.4320	62.6174

Correlation Analysis

NYILMB = LOG(CPUE + 1) FOR AGE-1 LARGMOUTH BASS IN SPRING WITH PREVIOUS YEAR'S HYDROLOGY

FR6_8	SREL6_8	SINF6_8	FR1_8	SREL1_8	SINF1_8	RIR9_11
0.90304	0.88001	0.83521	0.72062	0.69910	0.69883	-0.69401
0.0136	0.0207	0.0385	0.1062	0.1222	0.1224	0.1261
6	6	6	6	6	6	6

RIR3_5	RIR6_8	XCMS1_8	CASUSU	CASUSU2	SINF3_5	FR3_5
0.69015	-0.68325	0.68259	0.66143	0.66143	0.66081	0.65214
0.1291	0.1346	0.1351	0.1525	0.1525	0.1531	0.1605
6	6	6	6	6	6	6

SREL3_5	SREL9_11	XA6_8	PA6_8	XVOL6_8	XVOL1_8
0.60968	0.60638	0.58672	0.57594	0.57581	0.52252
0.1988	0.2019	0.2209	0.2316	0.2317	0.2876
6	6	6	6	6	6

APPENDIX C: WEST POINT (SPRING ELECTROFISHING)

Dependent Variable: NYILMB = LOG(CATCH + 1) OF AGE-1 LARGEMOUTH BASS IN SPRING VS. FLUSHING RATE (JUN-AUG)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.14272	0.14272	17.677	0.0136
Error	4	0.03229	0.00807		
C Total	5	0.17501			

Root MSE	0.08985	R-square	0.8155
Dep Mean	1.03553	Adj R-sq	0.7693
C.V.	8.67701		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-1.622245	0.63320108	-2.562	0.0625
FR6_8	1	2.683722	0.63830796	4.204	0.0136

Appendix D
Walter F. George Reservoir Correlation and Regression Results

APPENDIX D. Walter F. George Reservoir correlation and regression results based upon cove-rotenone sampling and spring electrofishing. Definitions of hydrologic variables are presented in Table 2. Fishery variables (N = 9) are defined in the correlation section.

APPENDIX D: WALTER F. GEORGE (COVE-ROTENONE SAMPLING)

Correlation Analysis
Simple Statistics for Cove-rotenone Data

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
SLM_KGHA	9	0.670490	0.363918	6.034412	0.023684	1.043925
ILM_KGHA	9	1.257179	0.186415	11.314608	0.891094	1.484479
NYILMB	9	1.257179	0.186415	11.314608	0.891094	1.484479
XVOL1_8	30	3.039217	0.014785	91.176500	3.000700	3.060400
XCMS1_8	30	2.202140	0.193292	66.064200	1.800700	2.536000
SINF1_8	30	3.803137	0.138572	114.094100	3.485900	4.021700
SREL1_8	30	3.805493	0.138581	114.164800	3.474200	4.035300
FR1_8	30	2.252123	0.044849	67.563700	2.147400	2.329200
RIR1_8	30	1.999390	0.003073	59.981700	1.995300	2.009300
XVOL9_11	29	3.034086	0.016354	87.988500	2.994900	3.054700
SINF9_11	29	3.112590	0.141366	90.265100	2.838900	3.385200
SREL9_11	29	3.102441	0.131987	89.970800	2.863800	3.361400
FR9_11	29	1.022428	0.040390	29.650400	0.951500	1.103600
RIR9_11	29	1.003214	0.012680	29.093200	0.960200	1.025100
XA9_11	29	4.230928	0.014419	122.696900	4.196400	4.249100
PA9_11	29	3.973248	0.008207	115.224200	3.953600	3.983600
CA9_11	29	0.041131	0.085920	1.192800	-0.116900	0.197600
XVOL3_5	30	3.040113	0.021743	91.203400	2.992300	3.063000
SINF3_5	30	3.453120	0.179364	103.593600	3.113300	3.769900
SREL3_5	30	3.454743	0.188329	103.642300	3.071500	3.790300
FR3_5	30	1.136413	0.061921	34.092400	1.005000	1.251800
RIR3_5	30	0.999703	0.007735	29.991100	0.987100	1.019200
XA3_5	30	4.118667	0.642146	123.560000	0.720200	4.256400
PA3_5	30	3.976323	0.010840	119.289700	3.952400	3.987700
CA3_5	30	0.037463	0.086783	1.123900	-0.116900	0.197600
CASUSP	29	-0.011600	0.064907	-0.336400	-0.135900	0.141100
CASUSP2	29	-0.023190	0.129805	-0.672500	-0.271700	0.282100
XVOL6_8	30	3.047187	0.018727	91.415600	2.997900	3.068700
SINF6_8	30	3.157740	0.146172	94.732200	2.701700	3.365200
SREL6_8	30	3.150423	0.145769	94.512700	2.756700	3.373900
FR6_8	30	1.033683	0.042963	31.010500	0.919600	1.101600
RIR6_8	30	1.002383	0.012806	30.071500	0.972600	1.026300
XA6_8	30	4.242487	0.016451	127.274600	4.199100	4.261400
PA6_8	30	3.979820	0.009354	119.394600	3.955100	3.990600
CA6_8	30	-0.195563	6.179185	-5.866900	-9.819200	16.706300
CASUSU	29	0.014310	6.103834	0.415000	-10.603600	12.670600
CASUSU2	29	0.028614	12.207666	0.829800	-21.207300	25.341100

Correlation Analysis
Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 /
Number of Observations

SLM_KGHA = LOG(KG/HA + 1) OF AGE-0 LARGEMOUTH BASS WITH CURRENT YEAR'S HYDROLOGY

XCMS1_8	FR1_8	FR3_5	SINF3_5	XVOL3_5
-0.78396	-0.74298	-0.73586	-0.73129	0.70605
0.0213	0.0347	0.0374	0.0393	0.0503
8	8	8	8	8

XA3_5	PA3_5	RIR9_11	SREL3_5	XVOL1_8
0.70472	0.70394	-0.69506	-0.59231	0.58342
0.0510	0.0513	0.0830	0.1218	0.1290
8	8	7	8	8

APPENDIX D: WALTER F. GEORGE (COVE ROTENONE)

NYISB = LOG(KG/HA + 1) OF AGE-1 LARGEMOUTH BASS WITH PREVIOUS YEAR'S HYDROLOGY

CASUSP	CASUSP2	XVOL3_5	XA3_5	PA3_5
0.92774	0.92747	0.86134	0.85973	0.85934
0.0076	0.0077	0.0127	0.0131	0.0132
6	6	7	7	7

XVOL1_8	XCMS1_8	SINF9_11	RIR9_11	FR9_11
0.74408	-0.63958	-0.54755	-0.54647	-0.51553
0.0551	0.1219	0.2608	0.2619	0.2952
7	7	6	6	

Dependent Variable: NYILMB = LOG(KG/HA + 1) OF AGE-1 LARGEMOUTH BASS VS. MEAN AREA CHANGE (SUMMER TO SPRING)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.03794	0.03794	24.715	0.0076
Error	4	0.00614	0.00154		
C Total	5	0.04408			

Root MSE	0.03918	R-square	0.8607
Dep Mean	1.35915	Adj R-sq	0.8259
C.V.	2.88268		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	1.437794	0.02249681	63.911	0.0001
CASUSP	1	1.769986	0.35603269	4.971	0.0076

Dependent Variable: NYILMB = LOG(KG/HA + 1) OF AGE-1 LARGEMOUTH BASS VS. MEAN AREA (MAR-MAY)

Analysis of Variance

Source	DF	Squares	Square	Sum of F Value	Mean Prob>F
Model	1	0.04968	0.04968	14.167	0.0131
Error	5	0.01753	0.00351		
C Total	6	0.06721			

Root MSE	0.05922	R-square	0.7391
Dep Mean	1.33568	Adj R-sq	0.6870
C.V.	4.43345		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-18.018876	5.14215591	-3.504	0.0172
XA3_5	1	4.571500	1.21455350	3.764	0.0131

APPENDIX D: WALTER F. GEORGE (SPRING ELECTROFISHING)

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
NYILMB	9	1.7515	0.3129	15.7639	1.0341	2.0717
XVOL1_8	30	3.0392	0.0148	91.1765	3.0007	3.0604
XCMS1_8	30	2.2021	0.1933	66.0642	1.8007	2.5360
SINF1_8	30	3.8031	0.1386	114.0941	3.4859	4.0217
SREL1_8	30	3.8055	0.1386	114.1648	3.4742	4.0353
FR1_8	30	2.2521	0.0448	67.5637	2.1474	2.3292
RIR1_8	30	1.9994	0.003073	59.9817	1.9953	2.0093
XVOL9_11	29	3.0341	0.0164	87.9885	2.9949	3.0547
SINF9_11	29	3.1126	0.1414	90.2651	2.8389	3.3852
SREL9_11	29	3.1024	0.1320	89.9708	2.8638	3.3614
FR9_11	29	1.0224	0.0404	29.6504	0.9515	1.1036
RIR9_11	29	1.0032	0.0127	29.0932	0.9602	1.0251
XA9_11	29	4.2309	0.0144	122.6969	4.1964	4.2491
PA9_11	29	3.9732	0.008207	115.2242	3.9536	3.9836
CA9_11	29	0.0411	0.0859	1.1928	-0.1169	0.1976
XVOL3_5	30	3.0401	0.0217	91.2034	2.9923	3.0630
SINF3_5	30	3.4531	0.1794	103.5936	3.1133	3.7699
SREL3_5	30	3.4547	0.1883	103.6423	3.0715	3.7903
FR3_5	30	1.1364	0.0619	34.0924	1.0050	1.2518
RIR3_5	30	0.9997	0.007735	29.9911	0.9871	1.0192
XA3_5	30	4.1187	0.6421	123.5600	0.7202	4.2564
PA3_5	30	3.9763	0.0108	119.2897	3.9524	3.9877
CA3_5	30	0.0375	0.0868	1.1239	-0.1169	0.1976
CASUSP	29	-0.0116	0.0649	-0.3364	-0.1359	0.1411
CASUSP2	29	-0.0232	0.1298	-0.6725	-0.2717	0.2821
XVOL6_8	30	3.0472	0.0187	91.4156	2.9979	3.0687
SINF6_8	30	3.1577	0.1462	94.7322	2.7017	3.3652
SREL6_8	30	3.1504	0.1458	94.5127	2.7567	3.3739
FR6_8	30	1.0337	0.0430	31.0105	0.9196	1.1016
RIR6_8	30	1.0024	0.0128	30.0715	0.9726	1.0263
XA6_8	30	4.2425	0.0165	127.2746	4.1991	4.2614
PA6_8	30	3.9798	0.009354	119.3946	3.9551	3.9906
CA6_8	30	-0.1956	6.1792	-5.8669	-9.8192	16.7063
CASUSU	29	0.0143	6.1038	0.4150	-10.6036	12.6706
CASUSU2	29	0.0286	12.2077	0.8298	-21.2073	25.3411

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0
/ Number of Observations

LOG(CPUE + 1) OF AGE-1 LARGEMOUTH BASS WITH PREVIOUS YEAR'S HYDROLOGY

XVOL3_5	PA3_5	SREL3_5	SINF3_5	XCMS1_8	FR3_5	RIR3_5
0.79278	0.79102	0.67682	0.65827	0.65516	0.65064	-0.61393
0.0108	0.0111	0.0453	0.0539	0.0554	0.0577	0.0786
9	9	9	9	9	9	9

SINF1_8	SREL1_8	FR9_11	FR1_8	SREL9_11	XVOL1_8	SINF9_11
0.57533	0.56700	0.55599	0.55161	0.52193	0.51174	0.46538
0.1050	0.1114	0.1201	0.1237	0.1495	0.1590	0.2068
9	9	9	9	9	9	9

APPENDIX D: WALTER F. GEORGE (SPRING ELECTROFISHING)

Dependent Variable: NYILMB = LOG(CATCH + 1) OF AGE-1 LARGEMOUTH BASS IN SPRING VS. MEAN VOLUME (MAR-MAY)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.49225	0.49225	11.843	0.0108
Error	7	0.29096	0.04157		
C Total	8	0.78321			

Root MSE	0.20388	R-square	0.6285
Dep Mean	1.75154	Adj R-sq	0.5754
C.V.	11.63985		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-54.727346	16.41209536	-3.335	0.0125
XVOL3_5	1	18.499538	5.37570075	3.441	0.0108

Dependent Variable: NYILMB = LOG(CATCH + 1) OF AGE-1 LARGEMOUTH BASS IN SPRING VS. MEAN PERIMETER AREA (MAR-MAY)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	0.49007	0.49007	11.702	0.0111
Error	7	0.29314	0.04188		
C Total	8	0.78321			

Root MSE	0.20464	R-square	0.6257
Dep Mean	1.75154	Adj R-sq	0.5722
C.V.	11.68344		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-145.761532	43.12147822	-3.380	0.0118
PA3_5	1	37.038252	10.82712322	3.421	0.0111

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13.ABSTRACT *(Maximum 200 words)*

This report describes an evaluation of existing data on hydrology and fisheries of reservoirs of the Alabama-Coosa-Tallapoosa (ACT) and Apalachicola-Chattahoochee-Flint (ACF) river basins for modeling effects of hydrology on fish reproductive success. Only 2 of 10 reservoirs in the ACF River Basin and 2 of 14 in the ACT River Basin had sufficient years of data for empirical analysis. Analysis of effects on fish reproductive success was limited to black bass in these four reservoirs because funding for the study was curtailed after historical databases were evaluated and described. With few exceptions, results for the four reservoirs indicate consistent positive relations of catches of age-0 black bass with current-year hydrology and age-1 black bass with previous-year hydrology. Correlation matrices and single variable regression models derived were concordant with effects described in the literature.

14.SUBJECT TERMS

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